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Whole body cryotherapy effects on the recovery in football

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This paper is published to encourage the sharing and transfer of technical data.

Introduction

To reach high levels of play, football players progressively increase their training and competitive loads. Football requires certain physiological characteristics because the nature of the activities is intermittent. Training therefore aims to improve the capacity to repeat high intensity exercise consisting of short sprints, directional changes, jumps, tackles and duel play (Stolen et al. 2005). Anaerobic energy release is determinant and the main training objective is to enhance all physical capacities (Bangsbo et al. 2006).

However, the high frequency and intensity of training and competition often cause considerable fatigue. The need to alternate work and recovery periods is therefore crucial to avoid overtraining (Halson and Jeukendrup 2004) and injury (Versey et al. 2013). Optimal training prescription consists of an appropriate balance of training stimulus and recovery and optimal planning. Coaches also use specific techniques to accelerate recovery and reduce the fatigue time. The best recovery enables football players to sustain greater training loads and to enhance its rate of progression.

Whole body cryotherapy (WBC) is a recovery technique that is becoming widely accessible to athletes. It consists of brief exposure to very cold air in temperature-controlled cryochambers where the air is maintained at –110°C to –140°C, generally for 2 to 4-min. Most of the studies since the late 1970s have focused on the effects of cryotherapy for pain symptoms in inflammatory disease (Banfi et al. 2010). However, WBC has been extended to sports medicine to treat injuries and overuse syndrome (Sutkowy et al. 2014) and to enhance post-injury recovery (Hausswirth et al. 2011; Hausswirth et al. 2012).

The literature review by Banfi et al. (2010) concluded that WBC is not harmful and has no general or specific negative effects on athletes. This recovery technique provokes no modifications in the biochemical or haematological parameters that raise the suspicion of cheating in athletes (Banfi et al. 2010).

Although a number of studies have reported the physiological responses to WBC, few have investigated the responses following training in a specific sport. Recently, Lombardi et al. (Lombardi et al. 2013) showed the effect of WBC on the haematological response in rugby players. Hausswirth et al. (2011) focused on the effect of WBC on exercise-induced muscle damage in well-trained runners after a simulated trail run. These authors compared several recovery techniques and found that maximal isometric muscle strength and perceived sensations were improved with WBC (Hausswirth et al. 2011). In 2013, Hausswirth et al. studied the parasympathetic response after two types of cryostimulation, WBC and partial body cryotherapy, in a population of healthy men and found that parasympathetic tone stimulation was greater after the WBC session (Hausswirth et al. 2013). However, this study did not include preliminary physical exercise.

Purpose

The aim of this study was to investigate the physiological impact of WBC as a recovery technique after a football training load. Moreover, WBC, cold water immersion and passive recovery were compared, with the expectation that post-exercise WBC would induce a greater magnitude of physiological responses and perceived sensations. We tested the following hypotheses: (i) WBC induces greater improvement in autonomic nervous system modulation by the parasympathetic action of heart rate than CWI or passive rest; (ii) WBC induces greater restoration of the sensation of comfort after training fatigue than CWI and passive rest; and (iii) the training load may be related to the recovery technique.

Methods

Nineteen football players performed three 4-min recoveries (WBC, CWI or passive rest) 30-min after 90-min training sessions in their usual conditions. We measured training load, squat jump performance (SJ), tympanic temperature (TT), blood pressure (BP), heart rate (HR), HR variability (HRV) indices, rate of perceived exertion (RPE), delayed onset of muscle soreness (DOMS), and thermal and comfort sensations (TS and CS). Data were collected before training (Squat Jump SJ), post-training (tympanic temperature TT, heart rate HR, blood pressure BP, RPE, DOMS), post-recovery at 5 min and 20 min (TT, HR, BP, HRV, RPE, DOMS, TS, CS) and the following morning (HRV, SJ). R-R intervals were used to evaluate autonomic nervous system modulation post-exercise and after a night's sleep. In the present study in according to literature, the activity of the ANS was studied through three components stemming from HRV: rMSSD, pNN50 and HF (rMMSD: Root mean square difference of successive normal R-R intervals; p NN50: Percentage of successive R-R differences >50-ms, HF: High frequency spectral). These components better reflected the parasympathetic activity.

Results

rMSSD increased significantly after WBC. pNN50 showed a significant difference 5 min after WBC compared with CWI and passive rest. For WBC, CWI and passive rest, pNN50 indicated a significant increase between 5 min and 14 hours post-recovery. HF was significantly increased at 5 min post-recovery with WBC compared with CWI and passive rest. Also, the difference in HF between 5 min and 14 hours post-recovery was significantly higher with WBC than the two other recoveries. WBC stimulated cardiac parasympathetic reactivation and improved comfort sensations. WBC and CWI decreased heart rate and perceived muscle pain more than passive rest. The aim of the recovery process is to accelerate the parasympathetic reactivation by restoring homeostasis and metaboreflex stimulation (Stanley et al. 2013).

Discussion

After a single WBC session, the recording 5 min later showed significantly increased rMSSD, pNN50 and HF compared with the values for passive rest (rMSSD: +22.74%, pNN50: +28.55%; HF: +16.51%). Cold water immersion was not shown to significantly increase rMSSD, pNN50 or HF compared with passive recovery. The greater effect of WBC on cardiac parasympathetic reactivation was induced by activation of the baroreflex and trigeminocardiac reflex receptors of the face when it is exposed to intense cold (Al Haddad et al. 2010).

Conclusion

The physiological benefits of WBC recovery were more pronounced than with CWI. In this study, we identified the differences in recovery effects and present new evidence that the responses to WBC are related to training load.

These R-R intervals correspond to time separating 2 cardiac waves of R-R. HRV consists in determining the HR all the time t. Every complex QRS is identified and allowed to isolate the successive intervals between R-R waves. Wave QRS or complex QRS corresponds to the depolarization or contraction cardiac ventricles, right and left. The wave Q is the first negative wave of the complex, the wave R is the positive complex component and the wave S is the second negative component. For improve the understanding, we propose the following figure.